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MEMORY, HISTORICALLY AND EXPERIMENTALLY CONSIDERED.

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II.

MODERN CONCEPTIONS OF MEMORY.

I.—*Disciples of Hartley.*

The writer last noticed in this sketch of the conceptions of memory was David Hartley. Before passing to the Kantians and the Scottish School, an Italian philosopher should be mentioned, who, whether a disciple of Hartley or not, taught an associational psychology very similar to that of the great English psychologist. I refer to Francesco Maria Zanotti, whose little treatise, *Della forza attrativa delle Idee*, appeared under the false date of 1747, purporting to be the work of a Frenchman.[1] This work contains Zanotti's views of memory.

Zanotti agreed with Malebranche in considering memory as a kind of habit. In his opinion, it is not a faculty. A faculty is given us by nature; habit is acquired. Memory comes in this latter way. It is formed little by little, by the repetition of feelings and thoughts. While explaining memory by the association of ideas, he invented a theory, not found in Hart-

[1] See Opere di F. M. Zanotti, tomo V, Bologna, 1790; also Ferri: La psych. de l'association, ch. III.

ley, to explain association. The attraction of ideas is the cause of association. What was little more than a figure of speech with Hume, became a psychological principle with Zanotti. He speaks not only of the attraction but of the electricity and magnetism of ideas, and he formulates the law that *the attractive force of ideas will be proportional to their fullness or perfection.* This attraction of ideas explains memory. According to Zanotti, "when we unite the idea of a certain thing with that of a certain time, these two ideas acquire by contact a kind of magnetism which causes one to attract the other; thus the force of reciprocal attraction is produced in the needle and the magnet when they have once been placed in contact. In the same manner, when the idea of a thing is awakened in us, it draws after it that of the time with which it has once been joined; and it is in this attraction that memory consists. Thus the thing reminds us of the time; and not less frequently the time reminds us of the thing. This is equally true of place; for the memory of a place brings back to us that of the event which happened there, and that of the time in which it occurred. These ideas of thing, of time, and of place having been once united, have acquired a sort of friendship—have become, so to speak, magnetic, and have begun reciprocally to attract one another."[1]

Among other disciples of Hartley may be mentioned Priestley and Erasmus Darwin. The last mentioned distinguishes ideas that we voluntarily recall as "ideas of recollection," those that recur involuntarily as "ideas of suggestion."[2] He argues vigorously for the

[1] Ferri, op. cit., p. 58.

[2] Zoonomia, Vol. I, §II, 2, 10.

theory that recollection is reproduced movement. He says: "If you wonder what organs of sense can be excited into motion when you call up the ideas of wisdom or benevolence, which Mr. Locke has termed abstracted ideas, I ask you by what organs of sense you first became acquainted with these ideas? . . . . If our recollection or imagination be not a repetition of animal movements, I ask, in my turn, What is it? You tell me it consists of images or pictures of things. Where is this extensive canvas hung up? or where are the numerous receptacles in which those are deposited? or to what else in the animal system have they similitude?"[1]

Abraham Tucker, another disciple of Hartley, deserves mention; for, while holding that an idea is a reproduced movement or cerebral modification of some kind, he avoids some of the objections usually brought against a physical theory of memory. He does not think that the motion or modification caused by our seeing an object persists until we see the same object again, perhaps a year afterward. Such a view would render necessary the supposition that "our internal organs must be as numerous as the ideas we possess." "But," he argues, "one substance may be susceptible of various modifications at different times, and as the same optic nerves serve to convey red, yellow, or green, according to the rays striking upon them, so the same internal organs may exhibit various ideas according to the impulse they receive from elsewhere."[2] That is, as I understand the passage, the

[1] Op. cit., §III, 6 & 7.

[2] Human Nature, Ch. VIII, §3. But see also §2, where he finds the analogue of memory in the visual after-image, and says that "our mental organs have a like quality with the bodily, of conveying perception to the mind when the causes setting them at work no

same nerves have the power of vibrating in different ways as the external stimuli vary. In like manner, the same nervous substance of the brain has the power to reproduce different vibrations as the stimuli vary; the stimuli in the latter case being, of course, either the sensations from external objects or associated ideas.

II.—*Kant and His Disciples.*

Kant's views of memory are presented at some length in his later writings.[1] But, indirectly, much is said about memory in the Critique of Pure Reason, in his discussion of the relation of the imagination to knowledge.[2] It is not necessary to present Kant's theory of knowledge here, but it will be remembered that the imagination mediates between sense and the understanding, partaking of the nature of both. It is allied to sense because we can imagine only sense-perceptions; it shares the nature of the understanding because it synthesizes the manifold of intuition according to the categories, and this synthesis is an exercise of the spontaneity of the mind. Kant distinguishes two forms of the imagination—the *productive* and the *reproductive*. So far as the imagination is an exercise of the spontaneity of the mind, clothing the pure concepts of the mind in sensuous form, he calls it *productive*. So far as it merely revives past sense impressions it is *reproductive*. The former acts according to universal and necessary laws; the latter, according to the empirical laws of association. The former may go

longer operate. For what the impulse of objects is to the optic or auditory nerves, that the impulse of these latter is to the mental organs; yet we see the idea of an object may be retained after both those impulses are over."

[1] See Anthropologie, §§27-33; also, Pädagogik, A.

[2] See the Transcendental Logic, passim.

beyond experience in the presentation of pure intuitions of space and time; the latter implies previous empirical perception. The former is the imagination of the poet and the painter; the latter, the ordinary power of any Gradgrind. The relation of the imagination to what is often included under memory is evident from Kant's definition of the former. "*Imagination*," he says, "is the faculty of perceiving an object without its presence."[1] He distinguishes memory from the reproductive imagination by limiting the former to the *voluntary* reproduction of a presentation. The productive imagination, he says, if mingled with memory, renders it false.[2] The highest act of memory, that of recognition, is, in Kant's psychology, a transcendental act of the ego.

Kant distinguishes three modes of memorizing—the mechanical (*mechanisch*) method, the method of clever devices (*ingeniös*), and the method of reflection (*judiciös*). "The first consists merely in frequent, literal repetition." The second is a method of learning given ideas by associating them with others, however incongruous, thus burdening the memory by the arbitrary association of disparate ideas. The third method is the best. It consists in classification, and will enable one by reflection to recall what is wanted.[3] Kant has no especial praise for the mnemonic art, and memorizing for mere discipline he deems useless. But in the Pädagogik he gives some advice for cultivating a child's memory.[4]

[1] Kritik der reinen Vernunft, Supplement XIV: "Einbildungskraft ist das Vermögen, einen Gegenstand auch ohne dessen Gegenwart in der Anschauung vorzustellen."

[2] Anthropologie, §33.

[3] Loc. cit.

[4] Pädagogik, Sämmt. Werke, Vol. IX, p. 403 (Rosenkranz-Shubert ed.).

Fichte develops the theory of memory involved in Kant's doctrine of the imagination.[1] According to his idealistic psychology, the power of imagination arises through the development of freedom in reflection. The imagination has the free power to renew external perceptions. In fact, we might say that the imagination is this power of renewing perceptions, for further activity of the imagination would be merely idle play. The possibility of reproduction of perceptions by reflection is always present. But this possibility is merely a norm of thought, according to which a perception would be actually reproduced. The gist of this norm is to direct the imagination how to limit itself self-actively in its survey of the whole field of reproducible perceptions. Such reproduction implies classification and keenness of sense-perception. The external senses do not give us the renewed perception, hence the imagination must have the power by its own causality of renewing the different elements of the original perception. The immediate perception differs from the reproduced picture in this: the latter is always accompanied by the consciousness of self-activity. The ego feels that it makes every feature of the picture. The actual perception, on the other hand, is always accompanied by the consciousness of lack of freedom. The act of reproducing a perception is, to quote Fichte's words, "a self-limitation of the imagination within its whole field in accordance with a limitation of the outer sense. The norm (*Regel*) of this limitation is the concept, namely, of the object of

[1] See Die Thatsachen des Bewusstseins (Vorlesungen, 1810–11), Ch. IV, and Zweiter Abschnitt, Anhang über das Erinnerungsvermögen. Also Die Thatsachen des Bewusstseins (Vorlesungen, 1812–13), Vortrag IX.

the external perception which is reproduced."[1] Fichte distinguishes two cases of the reproductive imagination, namely, when the reproduced impression is joined with the concept, and when it is not. In the latter case we have *unconscious reproduction;* in the former, *remembrance.*[2]

The aim of reproduction of perceptions is to get the external world independent of itself in our power. Henceforth we are free in reference to the world. We may let its stream flow or stop it at will. Hence the importance of cultivating the memory.

Fichte was always at his best when he left the transcendental heights of his philosophy and talked about practical matters. In his chapter upon the reproduction of impressions, he does not fail to add some good practical suggestions. It is well to have the parts of our free self-built world in a firm and lasting form. The imagination left to itself easily becomes confused. It must be limited. *Writing* is the means by which we may bind our wandering thoughts. If our thoughts are vague, we shall notice it when we write them down or when we test what is written.[3] For making the reproduction of visual impressions definite, Fichte also recommends *drawing.* Practice is the great means of strengthening the power of recollection. Fichte even says that "special natural endowment, talent, genius, or whatever we may call it, has no influence" on this power. The power of recollection is not an accidental phenomenon; "but it is a necessary and inseparable part of consciousness." Hence

[1] Thats. d. Bewusst. (Vorles. 1810–11), p. 43.

[2] Thats. d. Bewusst. (Vorles. 1812–13), Nachgelassene Werke, p. 494.

[3] His aphorism is: "Ein gründliches und durchgeführtes Denken wird, meines Erachtens, kaum anders gelingen, als mit der Feder in der Hand." Loc. cit., §9.

anything that benefits the mind is good for the memory. "The clearer, freer, and more self-controlling consciousness is in general, the more comprehensive and ready is the power of recollection. (The true principle of a system of mnemonics is the maxim, *sapere aude*)."[1]

Schelling has nothing to say upon the subject of memory that need detain us. F. A. Carus,[2] however, a disciple of Kant whose writings are little known in this country, treats the subject of memory more fully and, in some respects, more satisfactorily than either Kant or Fichte. He holds an idealistic doctrine analogous to the doctrine of physiological psychology, that all our experience modifies the brain-centers in their growth. Memory means continued assimilation. Everywhere in nature, action implies reaction. In the subjective world this reaction, according to his view, is an effect persisting in time. "The continued life of man is, however, an advance from an original state of indefiniteness and dependence to a condition of greater and greater definiteness and stability. . . . Hence the ability to appropriate experiences, changes, developments, and what is received from sensation or feelings, and to cause it to persist as one's inalienable inner possession. Even this ability may be looked upon as the condition of memory, if not as memory itself. What has been experienced continues to live in us. But nothing that persists in us enters the sphere of our consciousness, consequently not into the higher sphere of activity of the mind and will, nor into our free power, without continued activity; thus what has been experienced does not enter consciousness

[1] Anhang über das Erinnerungsvermögen.

[2] See his Psychologie, Bd. I, p. 217 seq.

without reproduction, without being made our own by repetition." Memory is not a mere power of receiving and of preserving impressions; "it is rather a power of making present and living what has been perceived, thought, felt, and willed, together with more or less of a revival of space or of time." Finally, memory is not a separate faculty, but is involved in the other powers of the mind.

Hegel's doctrine of memory is so interwoven with his metaphysical system that space cannot be taken for a presentation of it here.[1] But what has been said of Fichte's views is sufficient to show the general character of the German idealistic psychology of memory. The most important feature of it is the emphasis placed upon the *spontaneity* of the mind in memory. One other important part of this doctrine, however, must not be omitted.

How the mind can preserve ideas has been the problem that philosophers have wrestled with or ignored ever since the days of Plato. Some of the German idealists attacked the problem and attempted to explain this mystery of memory; or rather, like Diogenes, they reversed the problem and attempted to explain forgetting. Fries, professor at Heidelberg before Hegel, is a good exponent of their views.[2] He maintains, with Locke, that there is an internal sense that takes cognizance of our mental activity. He adopts the distinction usually made by careful writers, between memory and the power of recollection. Memory, according to his definition, is merely the power of

[1] For a discussion of the subject from the Hegelian standpoint see Rosenkranz's Psychology, pp. 267–327.

[2] See his Neue Kritik der Vernunft, Bd. I, §§29–36; Psych. Anthropologie, Bd. I, §§ 10, 11, 43; Logik, §§ 10, 132. Cf. the views of Carus given above.

preserving impressions that we have once had. Provided we do not mix the physical and the mental, it is his opinion that pure introspection will show that there is no difficulty in the theory of memory. Every cause in nature, once set in action, continues until checked by other causes. This law of inertia holds in the mental world as in the physical. Hence, "not memory and the preservation of presentations that have once been had, but the forgetting of them, requires special explanation."

To solve the problem of forgetting, we must notice the distinction between our clear and obscure ideas, or the relation of the inner sense to memory. Only the most lively activities affect the inner sense sufficiently to appear in consciousness; the quietly continuing changes remain for the most part obscure. "Hence we always notice our memory only in its influence on the internal perception of presentations. All ideas that we once have or have had, remain present to us; the whole stock of our presentations remains in the memory. But, as new impressions are continually pressing in upon the old and sharing the presenting power of the ego, this becomes more and more divided, the previous presentations are thrust back and very soon obscured. Hence, if earlier presentations are not from time to time renewed they gradually become weaker and weaker. In this manner we must conceive that our whole knowledge is always present in the mind, but that at each moment only very few presentations have sufficient clearness to reach consciousness, *i. e.*, to be perceived. Hence we can regard forgetting as only a gradual obscuring of our presentations, without needing to suppose that they are ever entirely lost to us."[1]

[1] Neue Kritik der Vernunft, Bd. 1, §30.

Recollection, or the return of obscured presentations to consciousness, according to Fries, is not properly a reproduction, but a reappearing. The two causes of recollection are an increased sensibility of the inner sense and an increased vividness of ideas brought about by association. In the phenomenon of association we find one idea so bound with another, that if one becomes clear again, the other grows clear also. "The law of the strengthening of one presentation by others, with which we here have to do, is the opposite of the law of the weakening of presentations that we found in the study of memory. Both rest on the meeting of presentations in one life-state, and in their affinity in respect to their origin. If one presentation meets another, then it weakens it, since both must share the mind's power in an equal degree. But if they have previously been together, and one is again strengthened, then it imparts this strength also to the other. . . . The different activities which the mind manifests at the same time belong to one act of the mind; the strengthening of a part of this activity is at the same time a proportional strengthening of this whole activity; that is, inner activities affect each other more or less by the law stated, according as they belong together in one action of the mind."[1]

This doctrine of memory was afterwards taught by H. Schmid,[2] and was adopted by Sir William Hamilton.[3]

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[1] Op. cit., §33.

[2] Versuch einer Metaphysik der inneren Natur, pp. 231–235. Quoted by Hamilton, Lectures on Metaphysics, L. XXX.

[3] Works, loc. cit.

III.—*The Scottish School.*

The views of Hume have already been noticed. Among other early Scotch writers who have something to say of memory or of the association of ideas are Hutcheson, Turnbull, and Henry Home. But the first representative writer of the Scotch School is Reid. He discusses memory at some length, but does not throw much light upon the subject.[1] "It is by memory," he says, "that we have an immediate knowledge of things past." In his opinion, "memory is an original faculty, given us by the Author of our being, of which we can give no account but that we are so made." The distinguishing feature of memory is that it implies belief in what we remember. Yet, sometimes "the memory of a thing may be so very weak that we may be in doubt whether we only dreamed or imagined it"; and children may be subject to illusions of memory. "Our notion of duration, as well as our belief in it, is got by the faculty of memory."

In discussing the subject of memory, Reid made some statements that are astonishing to most philosophers. "The knowledge which I have of things past, by my memory," he says, "seems to me as unaccountable as an immediate knowledge would be of things to come." He thinks it remarkable that men have found difficulty only in reconciling prescience with free acts. He maintains "that we can as little account for memory of the past actions of a free agent. If any man thinks he can prove that the actions of a free agent cannot be foreknown, he will find the same arguments

[1] See Essays on the Intellectual Powers of Man, Essay III.

of equal force to prove that the past actions of a free agent cannot be remembered."[1]

Reid maintains that association and vividness of ideas cannot account for memory. He appeals to consciousness to decide the point. "I could as easily believe," he says, "that a hat is a pair of shoes as that memory is a certain degree of vividness in ideas and of strength in their association." "A malefactor that is going to be hanged has a cluster of very vivid ideas, and very strongly associated, of what he is about to suffer, but it is not the object of remembrance but of foresight."[2]

James Beattie, a contemporary of Reid, wrote a popular dissertation upon memory, in which he repeated the usual stories and platitudes, and gave some excellent advice in regard to training the attention and the memory.[3]

None of the Scottish philosophers have described the facts of memory better than Dugald Stewart. He presents a good analysis of the subject as studied introspectively, describes the different varieties of memory, gives a collection of cases of remarkable memory, and discusses at length the means of improving it.[4] While he confines himself chiefly to the discussion of the well-known phenomena of memory and to the presentation of facts, he modestly presents a theory of the relation of memory to conception that contains the main features of the doctrine of memory developed more recently by Taine.[5]

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[1] Loc. cit., pp. 341 and 342, Hamilton's edition.

[2] MSS. papers by Dr. Reid, cited by Dr. McCosh. See Appendix, Art. III, pp. 473 and 474 of McCosh's Scottish Philosophy.

[3] Dissertations Moral and Critical, Dis. I.

[4] See Elements of the Philosophy of the Human Mind, Vol. I, Ch. V and VI.

[5] Intelligence, Part II, Book I, Ch. 2 and passim.

Conception, in Stewart's psychology, is "that power of the mind which enables us to form a notion of an absent object of perception, or of a sensation which it has formerly felt." In opposition to the generally received doctrine of his day, Stewart maintains "that the exercise both of conception and imagination is always accompanied with a belief that their objects exist." In most cases this belief is only momentary, and is "immediately corrected by the surrounding objects of perception."[1] When we recollect a past event in which an object of sense was concerned, the act of recollection involves an act of conception. But the former implies a belief in the past existence of the object; the latter, a belief in its existence at the present moment. How shall we reconcile this apparent contradiction? "The only way that occurs to me of removing this difficulty," says Stewart, "is by supposing that the remembrance of a past event is *not a simple act of the mind*, but that the mind *first* forms a conception of the event, and *then* judges from circumstances of the period of time to which it is to be referred. . . . So long as we are occupied with the conception of any particular object connected with the event, we believe the present existence of the object; but this belief, which in most cases is only momentary, is instantly corrected by habits of judging acquired by experience."[2] This reference of recollected events to the proper points of time in the past is "strikingly analogous to the estimates of distance we learn to form by the eye."[3]

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[1] Op. cit., Ch. III.
[2] Op. cit., Ch. VI.
[3] According to this view, there are three operations in any complete act of memory: (1) the reproduction of a previous state of consciousness—*i. e.*, an illusion; (2) the rectification of this illusion by the present state of consciousness; (3) localization in the past. See Taine, op. cit.

Thomas Brown, Dugald Stewart's successor at the University of Edinburgh, writes with his usual eloquence of memory. The main point that he brings out is that "memory is not a distinct intellectual faculty," but that "the state of mind in memory is a complex one," resulting from the combination of two elements, namely, a conception and a felt relation of priority. Moreover, he analyzes what he terms voluntary recollection, and shows that it, "whether direct or indirect, is nothing more than the coexistence of some vague and indistinct desire with our simple trains of suggestion."[1] He discusses the time-honored question of the relation of a good memory to intellectual power, and maintains that "it is not a good memory in its best sense, as a rich and retentive store of conceptions, that is unfriendly to intellectual excellence, poetic or philosophic, but a memory of which the prominent tendency is to suggest objects or images which existed before, in the very order in which, as objects or images, they existed before, according to the merely imitative relations of contiguity." Thus the difference between the ordinary man and the genius is, that in the mind of the former, ideas follow each other mainly according to relations of former contiguity, which are limited, while in the mind of genius they are suggested by the relations of analogy, which are infinite.[2]

Sir William Hamilton, the Hercules of the Scottish school, discusses memory and the association of ideas with his usual profoundness and display of erudition.[3]

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[1] Lectures on the Phil. of the Human Mind, Lect. XLI.

[2] Loc. cit.

[3] Lectures on Metaphysics, Lect. XXX, and Notes D** and D***, Ed. of Reid, Vol. II.

Yet his discussion presents little that is new. In the first place, by keen analysis and clear definitions, he avoids the confusion that is liable to arise in the use of the word memory.[1] He uses the word (as the most careful philosophers have done before his time and since) to denote merely retention. He has no good opinion of physiological hypotheses for explaining memory. "All of them are too contemptible even for serious criticism," he exclaims with dogmatic impatience. Nor are they necessary. The phenomena of memory present no difficulty. Forgetting is the puzzle. Here he quotes with approval from H. Schmid the theory of memory explained above in outlining the views of Fries. This theory of the persistence and obscuration of ideas, and his famous law of association by *reintegration*, are the most important features of his doctrine of memory and recollection. It is not necessary to repeat the former here; it is apart from the plan of this article to discuss the latter.

[1] In the following passage he points out the cause of the confusion in the use of this word: "Because the faculty of Conservation would be fruitless without the ulterior faculties of Reproduction and Representation, we are not to confound these faculties, or to view the act of mind which is their joint result, as a simple and elementary phenomenon. Though mutually dependent on each other, the faculties of Conservation, Reproduction, and Representation are governed by different laws, and in different individuals are found greatly varying in their comparative vigor. The intimate connection of these three faculties, or elementary activities, is the cause, however, why they have not been distinguished in the analysis of philosophers, and why their distinction is not precisely marked in ordinary language. In ordinary language we have indeed words which, without excluding the other faculties, denote one of these more emphatically. Thus in the term *Memory*, the Conservative Faculty—the phenomenon of Retention—is the central notion, with which, however, those of Reproduction and Representation are associated. In the term *Recollection*, again, the phenomenon of Reproduction is the principal notion, accompanied, however, by those of Retention and Representation as its subordinates." Metaphys., Lect. XXX.

IV.—*The English Associationists.*

The English associational psychology, as already indicated, began with Hume and Hartley, while others, notably Hobbes and Locke, had discussed the phenomena of association long before the appearance of the "Observations on Man." The Scottish philosophers also gave attention to the subject, and Thomas Brown might be classed with the associationists, so much importance does he give to what he calls the mind's capacities of Simple and Relative Suggestion.

The real successor of Hartley, however, was James Mill, and the latter treats memory at length.[1]

Mill analyzes the phenomena of memory carefully but not quite thoroughly. He distinguishes two cases —the remembrance of sensations and the remembrance of ideas. In the remembrance of a visual sensation, for example, there is the idea of a thing and that idea brought into the mind by association. "But in memory there is not only the idea of the thing remembered; there is also the idea of my having seen it. Now these two—1, the idea of the thing, 2, the idea of my having seen it—combined, make up, it will not be doubted, the whole of that state of consciousness which we call memory."[2] The last part of this compound is a very complex idea containing two elements—"*the idea of my present self*, the remembering self; and *the idea of my past self*, the remembered or witnessing self." In the moment of memory, "the mind runs back from that moment to the moment of perception. That is to say, it runs over the intervening states of consciousness called up by association.

[1] Cf. Analysis of the Phenomena of the Human Mind, Vol. I, Ch. X.

[2] Loc. cit., p. 329, J. S. Mill's ed.

But 'to run over a number of states of consciousness called up by association,' is but another mode of saying that 'we associate them'; and in this case we associate them so rapidly and closely that they run, as it were, into a single point of consciousness, to which the name MEMORY is assigned."

Thus the recognition of a *sensation* consists of "three principal ingredients: 1, the point of consciousness called the remembering self; 2, the point of consciousness called the percipient self; 3, the successive states of consciousness which filled up the interval between these two points." In remembering an *idea* the ingredients are the same, except that the second is the "conceptive self."

The phenomena of forgetfulness confirm this account of memory. "Every case of forgetfulness is a case of weakened or extinct association. I cannot remember the discourse that I learned years ago, because the few words that I recall fail to suggest the following words."

Illusions of memory occur when "a case of the memory of *ideas* comes to be mistaken for a case of the memory of *sensations*." This occurs to the liar, when, in continually repeating his story, he dwells lightly upon the idea of himself as fabricating it and strongly upon the idea of himself as an actor in it, until, finally, the strongly associated idea of the latter circumstance overpowers and destroys the weakly associated idea of the former.

To sum up our account in Mill's own words, "Remembering is associating." And memory "is an idea formed by association of the particulars of a certain train—a train of antecedents and consequents, of which the present feeling is one extremity."[1]

[1] Op. cit., Vol. II, Ch. XIV, §5.

The way in which Bain and Spencer have developed the associationist psychology and filled the gaps in the earlier form of it is too well known to be recounted here.[1] It is necessary to recall only a few important features of their doctrine of memory on its physiological side.

We have already had occasion to note the anticipations, notably by Bonnet and Erasmus Darwin, of Bain's famous doctrine, that when an impression is reproduced, "the renewed feeling occupies the very same parts and in the same manner as the original feeling, and no other parts and in no other assignable manner."[2] This, argues Bain, is the only view compatible with our knowledge of the nerves. In the case of the after-impression of sense, we must infer that the continuing sensation is the result of persistence of the nerve-currents aroused by the original stimulus. If impressions surviving their originals are due to persisting nerve-currents, it is likely that revived impressions are likewise due to re-induced currents, feebler but in the same nerve-tracks as were occupied by the original sensation. Observation confirms this doctrine. The recollection of language is suppressed articulation. The vivid thought of an action impels us to perform it. Lively imagination of a color fatigues the nerves of sight. The thought of laughter keeps the hysteric laughing; and the hypnotized patient acts out all ideas suggested to him.

The physical mechanism of retention is as follows, according to Bain: "For every act of memory, every

[1] For a valuable presentation of their doctrines, see Ferri: La Psych. de l'Association. Also for valuable additions and illustrations, see Hodgson's "Theory of Practice," Vol. I, B. I, Ch. III, and an article on "The Association of Ideas," by Professor James, in Pop. Sci. Monthly, March, 1880.

[2] The Senses and the Intellect, p. 338.

exercise of bodily aptitude, every habit, recollection, train of ideas, there is a specific grouping or co-ordination of sensations and movements, by virtue of specific growths in the cell-junctions."[1]

As retention thus depends on a physical process, it follows that acquisition is limited by the size of the brain. "We are all blockheads in something." Great capacity in one branch of education is apt to be purchased at the price of corresponding deficiency in something else. Yet, from a rough estimate, Bain compares the number of our acquisitions, motor as well as sensory, with the number of cells and fibers in the brain, and concludes "that there is no improbability in supposing an independent nervous track for each separate acquisition."[2]

Herbert Spencer studies the genesis of memory.[3] In the growing complexity of the adjustment of inner relations to outer relations that, according to him, constitutes the evolution of life, there comes a stage when there are only "fragments of correspondences" between the two. At this stage memory appears. In instinct, the process of adjusting internal relations to external relations is complete; in memory, there are at most only partial correspondences. Yet the germs of memory are found in instinct, *i. e.* in compound reflex action. For the nerve center receiving and co-ordinating a series of impressions cannot record all these impressions at absolutely the same instant; yet, as the appropriate reaction is a response to the whole group, it follows

[1] Mind and Body, p. 91, 2d ed.

[2] For details of his estimate, and for the way in which he supposes the nerve groupings arise and can be isolated, see Mind and Body, p. 96, seq. See also his article on "The Retentive Power of the Mind," Fortnightly Review, Sept., 1868.

[3] Psych., Vol. I, Part IV, Ch. VI.

that the first impression of the series must persist until the last is received. This persistence is weak memory.

Furthermore, when psychic states have been infrequently connected in a series, their cohesion is feeble and the transition from each state to the next in the series is slow—*e. g.* in learning a language. This deliberate succession of psychic states is one of the conditions of memory.

Again, it often happens that two groups of impressions, differing by only one or two elements, are responded to by very different reactions; (*e. g.* two animals that look alike, one of which retaliates when attacked and the other does not. Here the groups of impressions from the two animals are, for the most part, alike; but the appropriate reactions are very different, *i. e.* running away in the one case, attack in the other). When these particular groups occur infrequently, the appropriate reaction becomes undecided. For the common elements of the two groups tend to excite either of the two sets of action that have constituted the responses to them. Hence arises a conflict between the psychic states involved in the two movements, and they become merely nascent movements or tendencies. This is the beginning of memory. To quote Spencer's words: "In the chief nervous center the different impressions serve as different motor impulses; and these, being severally supplanted by one another before they pass into the actual motor changes, will each of them consist of an incipient or faint form of that nervous state which would have accompanied the actual motor change had it occurred. But such a succession of states constitutes *remembrance* of the motor changes which become incipient—

constitutes a *memory*. To remember a motion just made with the arm is to have a feeble repetition of those internal states which accompany the motion—is to have an incipient excitement of those nerves which were strongly excited during the motion. Thus, then, these nascent nervous excitements that conflict with one another are really so many ideas of the motor changes which, if stronger, they would cause; or rather they are the objective sides of those changes which are ideas on their subjective sides. Consequently, memory necessarily comes into existence whenever automatic action is imperfect."

Moreover, the sensory memory is a concomitant of the motor memory just described. As the external groups of relations become more complex and infrequent, the corresponding groups of impressions become less coherent, and a nascent memory of the component parts of a group becomes possible. General sensory memory is a derivative from this; "for the same progress which gives the ability to receive the complex impressions required to determine complex actions, gives the ability to receive complex impressions which do not tend to determine any actions at all." The latter class of impressions having no direct connection with action, have direct connection with each other in varying degrees of constancy, and tend to arouse one another in varying degrees. Hence arises that succession of ideas we call memory.

While "memory comes into existence when the involved connections among psychical states render their successions imperfectly automatic," the obverse of this is true; and when by multiplied experience the appropriate response to outer relations becomes structurally registered, then conscious memory passes into

unconscious or organic memory. Thus, while "instinct may be regarded as a kind of organized memory, on the other hand, memory may be regarded as a kind of incipient instinct."

V.—*Herbart.*

Turning back to Germany, Herbart and Beneke are the first prominent representatives of the "new psychology."

In the psychology of Fries we have already seen foreshadowed that theory of the inter-relation and ceaseless rise and fall of presentations over the threshold of consciousness that constitutes the static and dynamic of Herbart's psychology. But Fries emphasized the spontaneity of the mind, Herbart its receptivity. According to Fries, a presentation returns to consciousness because strengthened by another; according to Herbart, because an antagonistic presentation is arrested.

According to Herbart,[1] what occurs in the constant meeting in consciousness of new presentations with the old is this: similar presentations blend; contrary presentations mutually arrest each other; disparate presentations are complicated. But even arrest does not involve annihilation. The weaker presentations are obscured, but they persist as tendencies, and as soon as hindrances are removed they become actual; for presentations, by their very nature, are always striving for self-preservation. Reproduction is either immediate or mediate. It is immediate when presentations reappear in consciousness merely by reason of

[1] Cf. Lehrbuch zur Psych., passim; also, Psych. als Wissenschaft, passim. For a good account, in English, of Herbart's psychology, see also articles by G. F. Stout, in Mind, Nos. 51 and 52.

the removal of hindrances, and without help from presentations that have previously been blended or complicated with them. It is mediate when a presentation reappears in consciousness by the help of other presentations previously combined with it. A series of presentations is reproduced in consciousness in the same order in which it was originally perceived, for this reason: each successive member of a series blends with all the other members of the series that are above the threshold of consciousness, with an energy proportional to the vividness of the latter. For example, in series α, β, γ, δ, suppose that the presentive activity of β is at a maximum and α is sinking, when γ appears: then γ will combine closely with β, lightly with α. When δ appears, the presentive activity of γ is at a maximum, β is sinking, and α is fading from consciousness; consequently δ combines closely with γ, lightly with β, very lightly with α; conversely α, which combined closely with β, combined lightly with γ, and very lightly with δ. Hence, after the series has vanished for a time from consciousness, and the initial member is in some way reproduced, α recalls β with an energy greater than that with which it recalls γ, and so on; thus the series is reproduced in its original order.[1]

Thus in Herbart's psychology memory is no innate faculty, but is involved in the striving of presentations for self-preservation. Forgetting is the arrest of weak presentations by stronger presentations, and occurs because the simplicity of the soul makes it impossible for contrary presentations to coexist in consciousness. The obscured presentation has a latent power analo-

[1] Cf. Stout on the evolution and involution of series, op. cit., No. 51, pp. 334, 335.

gous to latent natural forces. Reproduction is the natural result of the irrepressible striving of presentations, and occurs *ipso facto* when obstacles are removed.

Beneke agrees with Herbart in combating the idea that memory is a faculty; and, with some change of terminology, his theory of memory is, in general, not essentially different from that just given, except that, according to him, presentations are not really in conflict, but a presentation becomes obscured because certain psychic elements are transferred from it to others, and it returns to consciousness because it receives an increased quantity of those elements.[1] In his *Erziehungslehre* he considers the pedagogical aspects of the subject.[2]

Among disciples of Herbart may be mentioned Drobisch, Volkmann, Dörpfeld, and Steinthal.[3] Of these, Dörpfeld emphasizes the comprehensiveness of memory, showing that all acts of thinking, comparing, and judging, and even the simplest perceptions of daily life involve memory; and as all reproduction is either immediate or mediate, as stated above, he attempts to reduce the laws of association to one law, and considers the important relation in which memory stands to thought. Steinthal considers the general principles of memory, and develops the Herbartian doctrine in harmony with his own theory of apperception.

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[1] See Lehrbuch d. Psych., Ch. III; also Die Neue Psych. and Psych. Skizzen.

[2] Bd. I, §§20–22.

[3] Cf. Drobisch's Empir. Psych., §§31–41 and 117; also his Mathemat. Psych., passim; Volkmann, Lehrbuch d. Psych., Bd. I, IV (this is especially valuable for many notes and references); Dörpfeld's Denken und Gedächtnis; Steinthal's Psych. und Sprachwissenschaft, Th. I, §§79–91 and passim. Also, for a good account of the views of Dörpfeld and Steinthal see Fauth's Das Gedächtnis: Gütersloh, 1888.

VI.—*Lotzė.*

Lotze, among recent philosophers, is the most able champion of the doctrine that memory is a "power of the soul to preserve impressions independently of physical conditions, and to unite them according to laws that have nothing in common necessarily with the modes of action of nerve-forces." Even if the opposite theory of the dependence of memory upon physical processes be tenable, he would choose the former for ethical reasons; for in the next sentence to that quoted he says: "Where two hypotheses are equally possible, one harmonizing with moral needs, the other at variance with them, nothing can turn the choice in favor of the latter."[1] Yet Lotze does not deny the influence of cerebral changes on the train of thought. On the contrary, he maintains that there is an interaction between mind and body, that "not only the nervous stimulation conditions a definite presentation, but also the presentation, emerging again in the course of remembrance, reacts and strives to reproduce that nervous state by which it was itself aroused in sense-perception."[2] But the brain is not the organ of memory; for, while admitting the indirect dependence of the train of thought on bodily processes, he says: "The doctrine of a special organ of memory, even as a mere means of support to the soul's own power of remembrance, is exposed to greater difficulties than is commonly thought. The objection that the cerebral mass, which is not unalterable, but undergoes slow renovation, could not, without confusion, retain for future use the impressed copies of countless impressions, is

[1] Medicin. Psych. §36, p. 473.

[2] Op. cit., p. 474.

met plausibly but not convincingly by reference to the countless undulatory movements of sound and of colored light that can simultaneously traverse the same atmospheric space without mutual disturbance."[1]

The images of sense-perceptions, Lotze argues, are not strictly images. The mind takes cognizance only of qualitative differences of stimulation. Sense-impressions are but *intensive* data by the help of which the mind by its own activity reproduces the external world. To suppose that the brain retains impressions of the countless images of sense is possible only on the hypothesis that each cerebral atom is capable of retaining in itself without mutual disturbance an infinite number of impressions. "Such a theory would simply contain many repetitions of the same supposition that we make once. If every several atom of the cerebral mass is capable of retaining without confusion numberless impressions, why should the soul alone, like the atom a simple being, be incapable of doing so? Why should it alone not possess the faculty of memory and recollection in itself without the aid of a corporeal organ, when we have to concede that faculty directly and without the mediation of a new instrument to every part of the assumed organ? Nay, we must, in fact, make the contrary assertion, that the retention and reproduction of impressions is possible, not to a number of co-operant cerebral particles, but exclusively to the soul's undivided unity. . . . . to admit an organ of memory would only lead to our having to attribute a memory to the soul, and also to regard the several atoms of the brain as souls whose power of remembrance assists ours."[2]

[1] Microcosmus, Book III, Ch. III, §5.

[2] Loc. cit.

Lotze, however, does not neglect empirical facts, but considers the relation of sense-perception to reproduction, and discusses the morbid phenomena of amnesia and hypermnesia, finding nothing that contradicts his theory of memory. His discussion of our subject is one of the ablest arguments in modern times for the transcendental theory of memory. Yet, as Horwicz says: "From this man we can learn to think upon psychological questions in terms of physiology."[1]

VII.—*Fechner.*

Fechner, in accordance with his Spinozistic principle of the double-aspect nature of the world, writes thus of memory: "Remembrances (*Erinnerungen*) are developed from perceptions, under the supposition of a universal consciousness in which both are included. Without knowing the psycho-physic processes which underlie the one or the other, we can, nevertheless, conclude according to the functioning principle, that the psycho-physic conditions of remembrances are developed out of those of perceptions, under the supposition of universal psycho-physic conditions which the nature of the universal consciousness demands."[2] These theoretic views we need not dwell upon here. Of special interest, however, are his observations in regard to the relation between after-images and memory-images.[3] According to him, the chief differ-

[1] Psych. Analysen, Bd. I, p. 272. For Lotze's discussion of the train of ideas and criticism of those who explain memory after the analogy of physical inertia (Fries et al.), and of the Herbartian theory, see Microcos., Book II, Ch. III, and Outlines of Psych., Ch. II. Cf. also Metaphysic, B. III, Ch. II and V.

[2] Elemente d. Psycho-physik, II, p. 380. I translate *Erinnerung* "remembrance" rather than "recollection" because the latter implies volition, while the German word as used here and below is not limited to voluntary recollection.

[3] Op. cit. II, p. 468 seq.

ence between the two consists in a feeling of *receptivity* connected with the former, in contrast with a greater or less feeling of *spontaneity* connected with the latter. He observed carefully the difference between memory-images and after-images in his own experience, and questioning others skilled in introspection—such men as Volkmann and Drobisch—found great personal differences in the vividness and distinctness of the memory-images.[1] At one end of the scale stood Fechner himself, with memory-images "incomparably less distinct" than after-images; at the other end the painter, reported by Boismont, who, in a half-hour's sitting, obtained such a vivid memory-image of his subject that it served him afterwards as a model.[2] The one distinction between memory-images and after-images found by all observers was, that while the former can be modified at will, the latter cannot be voluntarily changed.

Fechner distinguishes five classes of phenomena in respect to persisting images: (1) after-images, *i. e.*, after-sensations; (2) memory-images; (3) memory-after-images; (4) phenomena of sense-memory; (5) involuntary hallucinations. By the third class—memory-after-images—Fechner means memory-pictures formed immediately after the perception, and having, there-

[1] Cf. also Galton's observations in regard to Mental Imagery, Enquiry into Human Faculty, p. 83 seq.

[2] The painter described his method of work after such a sitting in these words: "Je prennais l'homme dans mon esprit, je le mettais sur la chaise, où je l'apercevais aussi distinctement que s'il y eût été en réalité; et je puis même ajouter avec des formes et des couleurs plus arrêtées et plus vives. Je regardais de temps à autre la figure imaginaire, et je me mettais à peindre; je suspendais mon travail pour examiner la pose, absolument comme si l'original eût été devant moi; toutes les fois que je jetais les yeux sur la chaise, je voyais l'homme." Brierre de Boismont, Des halluc., p. 39, quoted by Fechner.

fore, a vividness comparable to that of the after-sensation. Under the fourth class he includes after-images that appear involuntarily some time after the original sensation.[1] These different phenomena form a sort of gradation between the sensory after-image on the one hand and the memory-image on the other. Fechner concludes from his observations that the processes underlying the phenomena of after-images and of memory-images are essentially the same. If the psycho-physic process is aroused within and passes outward, we have a memory-image; if it proceeds from without inward, we have an after-image.

VIII.—*Horwicz.*

Horwicz makes an important contribution to our subject, by showing the relation of memory to feeling.[2] He distinguishes remembrance (*Erinnerung*) from mere memory (*Gedächtniss*), by limiting the former to cases where the time and space distinctions of the original presentation are revived, and using the latter to denote cases where only the content of the presentation is renewed. Considering the subject from a physiological standpoint, he shows that acts of reproduction are so involved in all psychic life, that the assumption of a special organ for memory is inconceivable. He would rather ascribe the power of reproduction in varying degree to the whole nervous system. We find the germs of memory even in simple reflex action. In case of the decapitated animal or the sleeping man, a futile movement for removing a stimulus is followed by a more appropriate one. This would be impossible

[1] This phenomenon was first mentioned by Henle.

[2] See his Psych. Analysen, Bd. I, pp. 265–331; also pp. 160 seq., 256 seq., 369 seq.

without remembrance of the first movement and its ineffectiveness. In Pflüger's experiment, the segments of an eel's tail react *from* the flame, not into it. "Hence it follows that remembrance (*Erinnerung*) dwells in each central organ, yes, even in each smaller complex of nerve elements."[1] Yet we may regard the great commissures of the brain as the most important organs of reproduction. The manifold trains of commissural fibers seem specially adapted to function the linking of our ideas; and there is no other use to which they do seem adapted.

The assumption of this physical basis for remembrance does not, in the opinion of Horwicz, prove materialism; for many facts tend to show that these fibers were developed by psychic activity. Nor does the anatomical structure of the commissural system lend support to the Herbartian psychology; for there is no one point (corresponding to Herbart's statical point toward which all presentations strive) toward which all nervous paths converge.

If reproduction is a function of one class of the commissural fibers, *i. e.* those of the brain, then "reproduction is a special case of association." Taking the spinal cord as the simplest example of a central organ, its three classes of commissural fibers, the lateral (uniting sensory and motor cells and functioning simple reflex actions), anterior (connecting motor cells with each other and associating movements), and posterior (connecting sensory cells with each other and associating sense-impressions), afford a physiological explanation of the association of presentations.

This, however, does not explain the preservation of

[1] Op. cit., p. 278.

impressions in memory. The simple remembrance of a former stimulus seems to be confined to the same nerve-fiber and cell as the original impression. But this is not so. We fail to recognize at once known objects in unfamiliar places. The prick of a pin we recognize whether on the foot or on the hand. Therefore remembrance does not occur in the simplest case without association.

Moreover, every sensory nerve-path passes through several cells. Hence it is probable, Horwicz concludes, that the sensation and the remembered sensation do not have their seat in the same cells, but that some cells are devoted exclusively to memory. Probably in the higher central organs a memory-fiber, at every station of the afferent nerve-path, branches off and ends in a terminal cell. In these memory-cells we must assume that a trace of the sense-impression is deposited, which trace is associated with new impressions as soon as the stimulus strikes the neural path concerned. We must not, however, suppose that this storing-up process is something peculiar to the so-called memory-cells. From the identity of nerve-structure we must rather assume that the process is the same on the whole neural path. But in the conducting fibers and the intermediate cells, we may suppose that, on account of their frequent stimulation and other functions, the storing-up process cannot so easily occur, but only a disposition to definite associations remains. "The universal law of the association of nervous excitations appears at the first stage as an accessory sensation (*Mitempfindung*) and an accessory movement (*Mitbewegung*), in the course of the nerve-path as a disposition, at the end of it as an after-sensation. The after-sensation is related to remembrance

as the accessory sensation and accessory movement to the association of sensations and movements."[1]

Thus reproduction is a kind of association, and association in its widest sense, *i. e.* the transmission of an excitation from one nerve-fiber to others, is a universal function of the central organ. Anatomical necessity conditions sensory and motor association originally, since the excitation must spread equally over all cells connected with the stimulated center. In this primary stage association appears as accessory movement or accessory sensation. Gradually, by chance or otherwise, the spread of the stimulus preponderates in one direction. This preponderance gradually increases until, finally, a decided inclination for a definite direction is formed. This transmission of a stimulus with a decided disposition is association in the narrowest or usual sense.

Leaving the motor side, and attending exclusively to the association of sensations, Horwicz gives the following definition as a résumé of what has been said: "*Reproduktion ist eine Uebertragung von Reizen überwiegend nach der sensiblen Seite in bestimmten durch Dispositionen angegebenen Richtungen und auf Residuen, die von älteren Reizzuständen aufbewahrt sind.*"[2]

Horwicz discusses the theory that explains memory after the analogy of the persistence of physical forces, and shows that the law of inertia cannot hold in the mental world in the same way as in the physical. In order really to understand the persistence that occurs in memory, we must understand the nature of sensa-

[1] Op. cit., p. 289. It should be stated that Horwicz offers this explanation only as an hypothesis.

[2] Op. cit., p. 291.

tion. The latter, however, is unknown. Therefore we can at most only investigate the relation of remembrance to sensation. It is apparently so easy to distinguish between sensation and remembrance that most psychologists have not thought it worth while to notice the distinguishing marks of the two. Fechner, however, gave special attention to this;[1] and the phenomena discussed by him show that remembrance is distinguished from sensation by the greater influence of the will in the former.

The persistence of presentations is no mere mechanical one. If the volition is the essential mark that distinguishes the remembrance from sensation, then it is also the ground of the persistence of the presentation. The persisting presentation is itself volition, activity, impulse. A sensation is essentially an impulse to movement, consequently the remembrance must be such an impulse stored away in the nerve-element. We may conceive of this physiologically as if a spring were made tense by pressure. Then suppose that a second spring is so united with it that when the first is pressed the second is made tense also, but is not relaxed when the first is relaxed. Imagine an infinite number of such spring-systems, of which now these, now others are affected, and in the elasticity of the second springs we have a fitting illustration of the preservation of the sense stimuli in memory.

Horwicz considers the relation between the conscious and the unconscious in our mental life, and shows that the transition from the one state to the other is ordinarily a gradual one. All psychic activities divide into the two classes of conscious and unconscious processes. These two affect each other

[1] Cf. supra.

reciprocally, the conscious drawing forth the unconscious, and the unconscious pressing upon the conscious.

The original sensation, the perception of a nervous excitation, is an impulse that shows itself immediately by translation into motion. The sensation also remains such an impulse if, instead of the motor path, it strikes the memory-cells. We have proof of this in the fact that presentations as well as sensations can originate movements, and that even unconscious presentations are wont to have clearly motor effects (*e. g.* in the case of the instantaneous movements for retaining one's equilibrium called forth by the unconscious or weakly conscious idea of the circumstances of the situation). How does this impulse suddenly become latent, and again suddenly become active? Or, in other words, how does the presentation suddenly vanish, and again suddenly appear? We say that a presentation vanishes when the attention is turned to something else. But it is a poor excuse for letting the soup boil away, that the cook was sprinkling the roast. It is commonly supposed that the soul, on account of its unity, is capable of but one presentation at a time.[1] But the unity of the soul does not explain the facts of the unconscious. How can we conceive the latter in terms of physiology?

The physiological explanation is found in the mechanism of inhibition or arrest. The strength and life of the *feeling* connected with a presentation gives it the power to obscure others, just as it is the will (*i. e.* the result of feeling) that inhibits movements. The attention may be divided among indifferent presentations, but presentations highly colored

[1] Cf. Herbart, supra.

with emotion thrust back all that resists them. We can easily note the feeling of effort that it costs to bring foreign ideas or sensations back to consciousness.

On the other hand, the return of presentations to consciousness is not so simple a matter as the Herbartians suppose. According to them, the presentation flies up like the spring when the pressure is removed. But the incalculable kaleidoscopic interplay of our presentations does not seem to conform to any such simple rule of arithmetic. "Not simple inertia, mere continuance, is sufficient to explain the persistence of presentations, but a continuing impulse, a constant act of life. Not the mere entrance of a new (opposite or however otherwise related) presentation is sufficient to arrest the former, but there must proceed from the new presentation a voluntary act of inhibition. So also the mere removal of the inhibition is not sufficient to allow the arrested presentation to appear again in consciousness, but living, and probably voluntary, relations must prevail between the presentations that arouse each other. Living impulses must condition the coming and going of presentations."[1]

In the development of our knowledge of the external world, movement and sensations of movement play a most important role. "But movement is the immediate result of the impulse involved in the sensation, *i. e.* of feeling. Consequently, we have to look upon feeling as the proper basis of remembrance." As feeling conditions voluntary and involuntary attention, thus, according to Horwicz, feeling is the ground of the persistence of presentations and of voluntary and involuntary remembrance. But the ground

[1] Op. cit., p. 314.

of the persistence of a presentation is a continuing motor impulse, *i. e.* the impulse to respond to a definite stimulus with a definite movement.

If feeling is the vehicle of the train of thought, it may seem strange that it is so hard to remember feelings. But it is not feeling, as such, which is the primary element in remembrance, but feeling in its necessary union with the feeling of motion. We can remember a feeling to the extent that we can reproduce the movements involved in it. Feeling is not directly, but indirectly, the basis of association. "Hence is explained how, on the one hand, feelings can most powerfully control and condition the train of our presentations, and how likewise, on the other hand, it is so difficult, yes impossible, to reproduce a feeling in itself."

Horwicz considers also the laws of the association of ideas, and maintains that in the traditional laws handed down from Aristotle, contrast is omitted, but that it is easily explained by his theory of feeling. Further, he considers the relation of his theory to the unity of consciousness, and finds the possibility of that unity in the connection of the nerve-cells in every direction.

IX.—*Wundt.*

Wundt's[1] theory of memory may be briefly stated. According to him, memory in its widest sense as the general power to renew presentations is the prerequisite for imagination and intellect. It has both a physical and a psychic side. On the physical side, it has its ground in those changes of sensibility that facilitate the return of conditions of stimulation that have once been

[1] See his Grundzüge d. Phys. Psych., Bd. II, Ch. 17, 2te Aufl.

aroused. The reproduction of vanished presentations depends on persisting dispositions to these presentations. All the phenomena of habit and of adaptation to circumstances indicate that the residua of impressions are functional dispositions. But "all reproduction proceeds from the presentations which are in consciousness, and the presence of unconscious dispositions does not revive the presentations, unless the necessary conditions for the forming of associations are present in consciousness itself. . . . The dispositions unconsciously present, and the degree of their registration, determine only what presentations in general can enter consciousness, but the actual entrance of any given presentation is always occasioned by the condition of consciousness itself."[1] Thus on the psychic side, reproduction is conditioned by psychic stimulation; and the starting point of recollection is always the present content of consciousness.

X.—*Organic Memory.*

The modern theory of unconscious or organic memory began long before Hering's famous lecture before the Imperial Academy of Sciences, at Vienna, in 1870. The germs of the doctrine are found in Malebranche. This Cartesian, as we have seen, explained memory by supposing that, when the brain-fibers have once received an impression, they acquire a facility of receiving the same impression again, just as the branches of a tree that have been bent in a certain manner acquire a readiness to be bent afresh in the same manner. Thus we think of the same things when the same cerebral processes recur. Moreover, in Malebranche's opinion, not the brain alone acquires

[1] Op. cit., p. 319.

this disposition to repeat changes that have once occurred, but the same is true of all parts of the body. Thus he says that, apart from consciousness, there would be no difference between memory and the other habits of the body.[1]

That Malebranche uses the word "habit" in referring to the repetition of organic processes, instead of the phrase "organic" or "unconscious memory," does credit to his clear thinking and to his care in the use of language. The defects in Malebranche's psychology of memory were due to the crude condition of physiological science at his time; but the distinction that he made between *memory* and *habit*, making the latter the genus and the former the species, has been, I think, the prevailing one among physiologists ever since.

Moreover, among German writers, Jessen, in his *Versuch einer wissenschaftlichen Begründung der Psychologie*, published in 1855, expressed a somewhat obscure doctrine of organic memory.[2] In his opinion, memory could, in a certain sense, be attributed even to things without life; for solid bodies retain impressions made upon them.[3] In illustration of this he cited such facts as the following. Musical instruments that have always been correctly played are superior in purity of tone. It is impossible to get an entirely pure note from a flute that has been wrongly played. The particles of the wood reproduce the accustomed vibrations. In all living organisms thought appears as a force existing in matter. Why, he asks, should not

[1] Cf. my preceding article, footnote 2, p. 68.

[2] Cf. Huber, Das Gedächtniss, p. 24; and Fauth, Das Gedächtniss, Ch. II.

[3] Cf. Draper, Conflict between Science and Religion, p. 132 seq.

the phenomena of thought be derived from thinking matter as well as the phenomena of electricity from electrical substances?

According to him, thoughts arise in one part of the brain, and come to consciousness in another part. The higher mental activities are located in the cortex of the cerebrum. If a clear image of an absent person is perceived, an efferent process from the brain-ganglia to the retina of the eye must be reproduced. Memory is no abstract property of the mind, but a universal property of nerves. In some inexplicable way, every impression persists in the nerves. The oftener and more strongly impressions are repeated, the more permanent becomes the effect upon the nerves, and the more easily can the appropriate movements recur. The ideas persist, not in the nerve-fibers, but in the nerve-cells. Hence, the special seat of memory is in the gray columns of the spinal cord, in the gray matter of the cerebral ganglia, and in the cortex of the brain.

This theory of organic memory was first brought into prominence, however, by Hering's lecture "On Memory as a Universal Function of Organized Matter,"[1] delivered before the Imperial Academy of Sciences, at Vienna, May 30, 1870. Starting from the law of the functional interdependence of matter and consciousness, and recognizing the necessity of supplementing physiology by psychology, he attempts to regard, under a single aspect, a great number of phenomena belonging partly to the conscious, partly to the unconscious life of organized beings. This common attribute is the

[1] Ueber das Gedächtniss als eine algemeine Function der organischen Materie. I have been unable to obtain this in the German, so have been obliged to refer to Butler's translation. See Butler's "Unconscious Memory," Ch. VI.

memory or power of reproduction in organized matter. Examining memory closely, we find it to be a power of our unconscious as well as of our conscious life. Ideas appear for a moment on the stage of conscious life, then vanish, and reappear to-morrow. Where have they been meanwhile? They do not exist as ideas. Between the "me" of yesterday and the "me" of to-day are vast abysses of unconsciousness. What is continuous is the disposition of nerve substance, in virtue of which it repeats to-day the processes of yesterday. Again, the train of our ideas seems often to disregard the order that would obtain in a series of cerebral processes. Here the organic processes are connected in an orderly manner, but not all the links of the series appear in consciousness. The bond of union, then, must be in the unconscious world; and as, "for purely experimental purposes, 'matter' and the 'unconscious' must be one and the same thing, so the physiologist has a full right to denote memory as, in the wider sense of the word, a function of brain substance whose results, it is true, fall, as regards one part of them, into the domain of consciousness, while another, and not less essential, part escapes unperceived as purely material processes."[1] Moreover, all the phenomena of habit and our automatic processes give repeated illustration of the power of reproducing organic processes without consciousness, due to the memory of the nervous system.

The same power of reproduction is found in other kinds of organized matter. The more a muscle is used the stronger it becomes. We have here, in its simplest form, the same power of reproduction that, in a more complicated form, is found in nervous substance. The

[1] Butler's translation, p. 111.

same is true in greater or less degree of all our organs. Increased use, alternating with periods of repose, gives the organ increased power of execution, increased power of assimilation, and a gain in size. Three things are involved in this: (1) internal alteration of the molecular disposition of the cells; (2) increase in the size of the individual cells; (3) multiplication of the number of cells. The last is a result of the other two; for, when cells have attained a certain size, they give rise to others that inherit more or less completely the qualities of the original cells.

This same power of memory is seen, according to Hering, in the facts of heredity. Acquisitions made during the life of the individual organism are transmitted to its offspring. In some mysterious way, the nervous system, in spite of its thousandfold subdivision into cells and fibers, forms a united whole, and even each cell of the more important organs is intimately related with the whole. This seems to be especially true of those germs marked out for independent existence, and each of these germs bears its part in the activities of the whole organism. Hence the offspring inherits the acquired peculiarities of the parent, or rather remembers them; for the descent of these peculiarities is a reproduction by organized matter of processes in which it took part as a germ in the parent organism, and of which it seems still to retain a remembrance, since, on occasion of given stimuli, it responds to them as the parent organism responded to the same stimuli. Thus the facts of heredity are as wonderful as when a gray-haired man remembers the events of childhood, but no more so.

If the germ can reproduce characteristics acquired by the parent, all the more will it be able to reproduce

those that have developed through countless generations in the organized matter of which the germ is a fragment.

"An organized being, therefore, stands before us a product of the unconscious memory of organized matter. . . . . Thus regarded, the development of one of the more highly organized animals represents a continuous series of organized recollections, concerning the past development of the great chain of living forms, the last link of which stands before us in the particular animal we may be considering. As a complicated perception may arise by means of a rapid and superficial reproduction of long and laboriously practised brain processes, so a germ, in the course of its development, hurries through a series of phases, hinting at them only."[1]

The memory of organized substance is especially seen in the phenomena of instinct. This power of remembering the experience of ancestors must be ascribed to the new-born infant as well as to animals. The brain processes upon which consciousness depends have had a less ancient origin than those relating to physical needs. Hunger and the reproductive instinct affected the oldest and simplest forms of organic life. Hence the memory of organized matter is strongest in respect to them.

Thus Hering finds the explanation of habit, instinct, and heredity in a phenomenon of consciousness, and, according to him, memory is a biological fact. "Man's conscious memory comes to an end at death, but the unconscious memory of Nature is true and ineradicable."

An interesting application of this theory to disease

[1] Butler's translation, p. 125.

has been made by Dr. Creighton.[1] Basing his opinion upon the principle of Hering that memory is a function of all organized matter, he uses the word *memory* in no figurative sense when he says: "Embryonic development, growth, and the continuity of organic life are the actual and explicit manifestations of that memory which was potential, implicit (and known to exist by inference only) in the sperm-particles and egg; just as consciousness is the actual and explicit manifestation of that memory which is potential, implicit (and known to exist inferentially) in the vast reserve of the unconscious which is at any given moment behind the scenes."[2] Applying his principle to many chronic diseases, he finds them characterized by a reversion to older and lower modes of life. The catarrhs, for example, "are a return, for a short time, to a more elementary, primitive, or embryonic kind of epithelial function."[3] Hence the value of alteratives consists in their habit-breaking or memory-breaking action. An alterative "effaces the memory of morbid action by substituting an action like it."

The terminology of those writers who use the phrase "organic memory" has justly been criticized. The phrase is at best a figure of speech, a kind of metonomy or synecdoche. All memory involves retention, and reproduction as well. But not all retention and reproduction involve memory. In the poverty of scientific language, the word *memory* is a very convenient term, and the extension of its meaning to include all retention of impressions by organic matter, and the functional disposition to repeat organic processes

[1] See his Unconscious Memory in Disease.

[2] P. 16.

[3] P. 37.

in general, has the advantage of showing the relation of memory proper to the physical processes that form in large part the subject-matter of physiology and biology, and it helps to unify in one concept many diverse phenomena—an economic device that is often valuable. But there are serious objections to such a use of the word *memory*. The idea of consciousness is so deeply involved in the connotation of the word that it should be restricted to its ordinary, limited use. And the extended use of the word is unnecessary; for what is this functional disposition to repeat organic processes but the law of habit? Habit and memory are intimately related, but the word *habit* is the broader term. To say that a diseased organ has lapsed into a bad habit is more in accord with custom than to say that it remembers an old and lower mode of functioning. To speak of the *habit* of a cell is not as confusing as to speak of *cell-memory*. The fact of the retention of impressions and the reproduction of physiological processes by organic matter, no one will deny; but "it is no more fitly called 'organic memory' than are the molecular alterations produced in the wood of an old Cremona."[1]

XI.—*Conclusion.*

The number of modern writers who have discussed the subject of memory is legion. It is impossible to mention them all here. But the writers whose views have been presented in this article are representative men, and their theories illustrate the conceptions of memory prevalent in their respective schools. The continued Platonic and Aristotelian influences may still be noticed in these modern theories; the former

[1] Prof. Ladd in Elements of Phys. Psych., p. 554.

appearing especially in the transcendental conception of memory, which was taught by the German idealists, and appeared in modified form in the Scottish School, and later found its ablest champion in Lotze; the latter appearing more or less in the empirical conceptions of the Associationists, Herbartian as well as English, and in modern physical theories.

Finally, it must be plain that, whatever be the relative merits of the idealistic and the physiological theories of memory, the facts of introspection have been pretty thoroughly worked over in the continued discussions of memory, from the days of Plato and Aristotle down to the last German student who has contributed a thesis *Zur Theorie der Reproduction*. After our historical orientation, the quarter of the horizon that looks most promising is in the direction of empirical study. In a future article I hope to notice briefly some recent views omitted in the present chapter, together with the empirical studies of Ribot, Kraepelin, Ebbinghaus and others, and to add the results of some experiments of my own.